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ABSTRACT

This paper presents a review of selected literature relevant to a general question of hemispheric specialization (right or left brain) and questions of gender differences in spatial abilities among a group of art students. Three basic questions for discussion are proposed: (1) is there a relationship between hemispheric dominance and spatial intelligence?; (2) is such a relationship gender based?; and (3) what are the implications for art education from these selected studies? The paper is designed as a means of generating hypotheses concerning gender differences that could be employed in future empirical research in this general area. The paper refers to selected studies and was conceived as a review paper in which the integration of bodies of research is presented in relationship to education in the arts. Contains 30 references. (Author/BT)

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by Harold J. McWhinnie

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QUESTIONS OF BRAIN HEMISPHERIC SPECIALIZATION AND GENDER DIFFERENCE IN SPATIAL TESTS

Abstract:

This paper presents a review of selected literature which seems relevant to a general question of hemispheric specialization (right or left brain) and questions of gender differences in spatial abilities among a group of art students. The paper is designed as a means of generating hypotheses concerning gender differences that could be employed in future empirical research in this general area. While the paper refers to selected studies it does not report data but was conceived as a review paper in which the integration of bodies of research is presented in relationship to education in the arts.

Introduction

Studies by Roach (1993) and Mc Whinnie (1993) on the spatial reasoning of the art student reported data which failed to replicate the previous findings by Eliot and Ho (Eliot,1988) and others that there were clear gender related differences on the Spatial Dimensionality Test or SDT (Eliot, 1984). A review of studies in the reported literature show a rather clear pattern of signficant differences which favor the male over the female within the general college age population.

The findings by Roach and Mc Whinnie replicated similar results reported by La Pierre (1993). These issues shall be reviewed in terms of hemispheric specialization and dominance. We will propose three basic questions for our general discussion which are:

1] Is there a relationship between hemispheric dominance and spatial intelligence?

2] Is such a relationship gender based?

3] What are the implications for art education from these selected studies?

A QUESTION OF CEREBRAL DOMINANCE?

Joseph (1988) found , based on a review of numerous studies conducted on normal, neurosurgical, and brain-injured individuals, that the right cerebral hemisphere appears to be dominant in the perception and in the identification of environmental and nonverbal sound; the analysis of geometric and visual space (depth perception and visual closure); somesthesis; stereognosis; the maintenance of the body image; the production of dreams during REM sleep; the perception of most aspect of musical stimuli; and the comprehension and expression of prosiodic, melodic, visual facial, and verbal emotion. (Joseph 1988)

Joseph's classification of those mental attitudes connected to the right cerebra (right brain) are more complete, descriptive, and based on research then the popular view of the right brain that has been popularized by writers within art education, such as Edwards(1978,1987). It was the writings of Edwards that identified and injected the general question of cerebral functions into the issues concerned with the teaching of drawing.(MC Whinnie,1983)

Based on studies of normal and split brain functioning, it appears that the right hemisphere maintains a highly developed social, emotional, and mental system which can independently perceive, recall and act on certain memories and experiences without the aid of active reflective participation of the left cerebral cortex. This leads to situations in which the right and left hemispheres of the brain sometime act in an uncooperative fashion, which gives rise to inter-manual (differences between actions) and intra-psychic (differences between words and

memories) in conflicts between the two cerebra.

While Joseph presents what migh be called the liberal classification of right and left brain functions, there are others in neurocognitive science such as Hellige (1993) who have questioned this system of classification. For Hellige and others, the brain ought be viewed as one, with the focus on communications between hemispheres rather then on the differences. Hellige represents what we will describe as the conservative point of view and Joseph the liberal.

The conservatives come from a knowedge base in experiemental psychology whereas the liberals seem to come from clinical psychology. One is more concerned with the description of the population and the other with a focus upon individual differences. The liberals tend to focus more upon human and social questions such as those that have been addressed by La Pierre in her research.

La Pierre (1993) has noted that since Broca's school of thought in the 1880's proclaimed women to be inferior to men and akin to blacks and apes because of a smaller size of the brain; these kinds of brain studies have demonstrated a false view of gender differences. In La Pierre's view the generalizations based on observed gender related differences on spatial tests only reinforces the 19 th. century point of view towards the female gender.

For Broca and Wierenke, female and non-western subjects were not considered to be well developed in terms of cerebral development and represented inferior forms of the human evolutionary process. These late 19 th. century views

affected education and society's treatment of women and of blacks as inferior groups. To some extent, both Broca and Wieranke misinterpreted the earlier theories of Wigan (1844) that the duality of mind produced two cerebra (hemispheres or laterialization) that for all intents and purposes were independent minds.

There is a large body of knowledge that confirms the lateralization of the brain for different cognitive functions as described by Joseph. (Mayer, 1983; Halpern, 1992). Hemispheric dominance does not mean an either\or division of tasks. It means instead that one half of the brain is more or less specialized or proficient in its' ability to process certain types of stimuli. Joseph's work does seem to indicate that individuals learn to prefer the initial use of one cerebra over the other for many specific tasks. The emphasis here is upon specific tasks and upon the initial reaction of the right or left brain. There are relationships between cerebral preference and cerebral dominance.

According to Sperry and Ploude (1984) views of the unilateral neglect syndrome caused by right sided focal lesion generally imply that the left hemisphere is lacking in awareness for the left half of the body and its' surrounding space. This assumption was questioned on the basis of previous split brain and hemispherectomy observations. Results for the left disconnected hemisphere (the corpus callosum is divided in an operation and this causes the two cerebra to not be aware of the sensory inputs to the other) revealed substantial awareness for the left side of the body and also for extrapersonal space. It was inferred that the left hemisphere, functioning independently possessed the requisite cognitive

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mechanism needed to prevent the appearance of the typical neglect syndrome as observed following right sided lesions. The researchers propcsed that the eventual explanation of this disorder must therefore account for the lack of left hemisphere compensation. The point in these findings is that the theories of separation of cerebral functions are not so clear as first described by Wigan (1844) and others.

More recent research reviewed by Hellige and others tends to extend the above argument. It would seem that while the initial set to respond is controled by hemispheric preferences, very quickly both hemispheres are involved in most cerebral tasks. Dominance would seem to be more of a question of the preferred initial response under direction of one hemisphere but which very quickly involved the actions of the whole brain.

The problems for the art educator in the use of materials from the brain sciences; how to make generalizations about" wellness" that are based on data from" illness"? A second question which arises from this study is, that if the left cerebra can function independently then cannot also the right cerebra in matters of right sided neglect?

According to Martin (1985) his findings suggest that in the normal brain, the right hemisphere may be involved in visual attention and spatial functions, regardless of the field of presentation in regard to the left or right hand ; or the left or right eye. Their findings suggested a qualitative limitation on the type of information which may be transferred via the anterior commissure, possibly due to the inability of the temporal lobe neurons to encode organized information of a

spatial and perceptual nature.

The studies just reviewed present two problems which are critical to the use of such bodies of research in visual arts education. These limitations are:

a] The data is based on matters of" illness".

b] The models of brain hemisphere laterialization, which many in the arts have embraced, needs to be reconsidered in terms of the more complex research that has been generated and reported in the literature within the past decade.

Damasio (1986) asserted that although it has been established that the left cerebral hemisphere subserves spoken language, the nature of brain organization for sign language remains relatively unexplored. The issue is especially important because sign language displays the complex linguistic structure of spoken languages, but convey it through manipulation of visuo-spatial relations. Their data suggests and adds a further support to the notion that anatomical structures of the left cerebral hemisphere subserve language in a visuo-spatial as well as an auditory mode. This data indicates that it may not just be spatial data but the mode of the data which determines which cerebra is called upon in the processing of the sensory input. Whether it is presented to a subject spatially or verbally, the information is still sequential and more suited to the analytical style of the left cerebra then it would be to the holistic style or the leaping thought style of the right brain.

This places a rather different dimension to questions studied in the split-

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brain research. Question of holistic vs. analytical bring us directly to questions of gender differences and to relationships to studies in spatial ability with a special reference to the spatial ability of art students.

GENDER RELATED DIFFERENCES

As to the question of gender differences, Gallusico (1987) studied and investigated the effects of spatial and verbal tasks on subsequent strategies for men and women on a parafoveal task ( ).Thirty men and 30 women, performed a parafoveal task which had been previously demonstrated to show no visual-field advantage. Their results showed that mental activity resulting from the spatial and verbal tasks produced a right field (left cerebra) advantage on the task which was significantly greater for men then for the women.

Since handedness seems to be at best an incomplete means of cerebral dominance identification as cited in research by La Pierre. (La Pierre,1993) A report by Wagner and Wells( ) indicated that there are reliable measures which are located in the medical literature base and have not been accessible to many in the arts or in education. With the advent and rapid growth of neuropsychology has come the need for reliable and valid measures of neuropsychological behaviors. The report described an inventory that measures neurobehavorial preference (differences in right and left brain preferences) based on theoretical assumptions and previous research findings in the field such as brain localization and cerebral hemispheric dominance. This inventory consists of 12 items, each of which has four statements that relates to four different functions of the two hemispheres;

left, logical

left verbal

right, manipulative/spatial

right, creative

When six different criterion groups were employed, artists, nurses, and teachers; the instrument appeared to be suitable for use in personality research, counseling, or in management. This provides a very useful inventory that can be employed outside of the medical setting and which will do more to identified variables of cerebral dominance then hand preference. In many ways this instrument is more usefull within the educational setting then are the very complex laboratory and experimental methods used by Hellige and others in their research.

Gallusico (1984) reports data from two studies which tested the multiple resources model of information processing using tachistoscopically lateralized (inputs that are presented to only one cerebra or hemisphere at a time) input. Their results led to the speculations that: [1] each hemisphere has unique pools of resources, that;[2] the resources of one or both hemispheres may be functional in processing a given task; and[3] that in dual task situations the brain operated most efficiently and accurately with direct access of appropriate tasks to each hemisphere.

Similar findings can be seen rather clearly in the results of a study reported by Bruger (1984).Research efforts have shown that the real impairment in response to faces and to facial expressions by right brain damaged subjects was reduced

inputs. Reanalysis of these data supports the hypothesis of differential hemispheric sensitivity to spatial frequency of inputs and shows processing of expressions partially dependent on the processing of faces.

All of these studies have in various ways confirmed earlier studies of cerebral lateralization as not being totally independent. The role of the corpus callosum (those fibers which connect the two hemispheres of the total brain) is emerging in the research as a critical element in the total brain process.

Sine (1984) demonstrated that data from stroke patients could be used for a wider range of generalizations about brain lateralization issues. In this case the patient recovered functionally almost completely but testing demonstrated continued loss of interhemispheric transmission. This case is considered of interest for this potential in explaining phenomena observed in severe unilateral hemispheric lesions. The findings suggested that preservation was not a dysfunction of the damaged portion of the brain but a phenomenon associated with intact brain attempting unfamiliar tasks. The persistence of left hemi-inattention is attributed in this case to the inability of the left cerebra to utilize spatial information to compensate for the phenomenon of inattention. In this case recovery of function following severe unilateral lesions was largely due to compensatory learning by the intact hemisphere and assertion of ipsilateral control(same sided). As the patient originally assumed an inverted left handed writing posture, we assume the posture was controlled by the right cerebra.

Researchers, as cited in La Pierre (1993) are still questioning whether the

brain is the same for male and female. According to Gersh and Gersh (1981) and Halpern(1992) microscopic examinations of the structure of the nerve cells and nerve tissues that comprise the brain show that the cells are morphorically identified except for visible x chromosomes in females and y chromosomes in males. There are some sex-relate brain differences but according to Halpern theses do not seem to involve higher functions.

According to Halpern, (as cited in La Piere, 1993) hemisphere dominance does not mean an either\or division of tasks. It means instead that one-half of the brain is more or less specialized or proficient in its' abilities to process certain kinds of stimuli.

There are some gender related differences in hemispheric dominance and handedness. Coren (1990) states that a greater proportion of males than females are left handed and thus left handedness is statistically associated with being male and right handedness with being female.

The question poised by La Pierre (1993) is how can handedness be determined effectively and does this indicate the true hemispheric dominance of the individual and if it does, what does this really mean for those in visual arts education? A search of NIH medline data bank produced only a few tentative studies which attempted to relate handedness, spatial skills, gender differences and creativity in the arts. A computer search produced no titles when the four variables were employed.

Levy (1976) reports data to suggest that females are more likely to involve

both hemispheres when solving spatial tasks then are males. The EGG patterns show that boys tend to use their right brains when performing spatial tasks while girls use their left hemisphere for both spatial and for verbal tasks.

SUMMARY

When we consider our art school data the question of the lack of information on gender differences haunts our interpretation of some of those questions of hemisphere specialization. Do males use both hemispheres as do females or are the females become more specialized in terms of the right cerebra processes on spatial tasks, like their male counterparts?

Our hypothesis is that females in our art school sample become more specialized, become more right brain dominant like their male counterparts. In other words, the lack of significant gender difference on spatial tests might well be attributed to the males and the females being more alike then different in regard to the visual arts setting at least.

The research data in this area is quite tentative but it does seem to be at least a working hypothesis for the clear results of no gender differences found in the Roach and the Mc Whinnie studies. Those studies summarized the results of a ten year study of the spatial intelligence factors of the students at the Maryland Institute College of Art in Baltimore. We turned to a consideration of the neurological literature as part of our search for an answer to the discrepancies noted between the art school data and the published literature on gender differences on spatial tasks.

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